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history of a theory which not only explains the origin of life-forms, but has transformed the methods of the historian, placed philosophy on a higher plane, and immeasurably widened our views of nature and of the Infinite Power working in and through the universe.

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*Materials for the Study of Variation.*—WILLIAM BATESON.—London and New York, Macmillan & Co., 1894. xv + 597 \$6.50.

Over thirty years ago Mr. Darwin outlined the great problems for investigation in natural history, and, one after another, these lines of investigation have been studied by naturalists. Embryology, paleontology and systematic classification early attracted the attention of many naturalists, and these branches of investigation have been very thoroughly studied in the last quarter of a century. Geographical distribution was made a special subject of research by Mr. Wallace and others. These various lines of study, while, of course, they have not been exhausted, have certainly been studied to such an extent that most of the valuable lessons which they teach have been learned. In recent years also another factor of the evolution problem, namely, that of heredity, has been the subject of eager research by various naturalists. It is somewhat strange that the problem of variation has been so universally neglected except by Darwin's *Animals and Plants*. It is upon variations in animals that the whole of the theories of Darwin and all evolutionary doctrines are based, but while the last thirty years has seen much speculation as to variations, both concerning their causes and distribution, while many illustrative instances have been accumulated, while nearly all the modern theories of evolution are based directly upon certain conceptions of variation, there has been no systematic attempt to study

this fundamental problem. Speculative zoölogy has always a greater attractiveness to most minds than the more laborious and less entertaining work of collecting facts. The last twenty-five years has seen an abundance of publications upon evolution from theoretical grounds, and while variations themselves have been discussed on both sides of the Atlantic, these discussions have been almost universally based upon a few stock illustrations, and must be recognized as without any proper foundation in facts. Natural science is certainly indebted to Mr. Bateson for having taken up at last this branch of research which lies at the very foundation of the origin of species. Mr. Bateson's book has a very modest title, and the author simply claims to have brought together materials out of which a theory of the origin of species may in the future be built. But this is the only systematic attempt yet made to study variations themselves. The present volume is only the first instalment, and we are promised more in the future. A book of nearly 600 pages, filled with numerous illustrations, describing in more or less detail variations of all kinds, in all types of animals, will certainly find its way into the library of every naturalist who has any interest in speculative thought.

A review of this character is hardly a fitting place to discuss the subjects presented in this work. In reading over its pages there are, however, three or four striking conclusions of so much general theoretical importance that they may be selected as the teachings of this first volume. Most prominent among them stands the deduction of the author that variations are discontinuous. It is the theory of Darwin, and, in general, of his followers, that species were produced by natural selection acting upon slight continuous variations. The difficulties of this thought were plain to Mr. Darwin, and have become more plain

and more forcible as the years have passed. While the followers of Darwin's views have tried to shut their eyes to them and have tried to explain away the objections that have arisen, it has been plain to every thinking naturalist that the natural selection of minute accidental variations is entirely inadequate to accomplish the great end of producing species. The most important result of Mr. Bateson's study of variations is that the variations that occur in animals are not minute and continuous, or, rather, that they are frequently discontinuous. By this term the author means that variations may be sudden and extreme in character, such as the sudden development of a new tooth in a single generation, or the appearance of a new leg, or some other very prominent characteristic which appears at once without the numerous intermediate stages which Mr. Darwin's theory assumes. While Mr. Bateson does not claim that this view is demonstrated by the facts now collected, he does insist that all of his data point in that direction. The extreme significance of this conclusion upon the question of the origin of species is plain at once. A second conclusion which one reaches in the perusal of these instances is that variations are not haphazard, but, while, of course, they cannot be predicted with certainty, they do fall under certain definite laws. Mr. Bateson has found it possible to group the variations that occur in animals under very definite classes, so definite that, in many cases, at least, it is impossible to question that they are regulated by some organic law. Of course, Mr. Darwin recognized that variations had their causes, but, nevertheless, he was inclined to believe that they were 'par hazard.' According to the conclusions of Mr. Bateson, however, they are of a more or less definite nature. Incidentally also Mr. Bateson points out that the study of variation gives us a new conception of homology, and almost deprives

us of the belief in the long recognized law of reversion. It is somewhat surprising to be called upon to abandon the law of reversion, and perhaps the author does not deny that it may be a factor in development, but he does claim most of the instances so explained have nothing to do with this principle. It is not possible here to dwell further upon the many suggestive facts which are brought out by this study.

In criticism one may say that the English is extremely poor. The subject, of course, is a difficult one, and the author is obliged to use a new terminology and to explain his principles as he progresses. This in itself renders the book somewhat obscure, but we must add to this the fact that in many cases his sentences are very involved and cumbersome, and altogether the work is difficult reading. We may also somewhat regret that the author does not weave into the work a few more suggestions as to the significance of some of the facts that he has treated. The great part of this work reads like a museum catalogue, and museum catalogues are much more intelligible if one understands the basis of classification. Mr. Bateson, however, distinctly states that he does not consider the evidence as yet sufficient to warrant conclusions except in regard to some few general subjects. One may also question if most of his material does not savor too strongly of abnormal, and, indeed, almost pathological variations, to fairly serve as a basis for a theory of the origin of species. But, in spite of one or two such minor criticisms, the book of Mr. Bateson is an extremely valuable addition to zoölogical literature, and when it is completed by subsequent volumes upon variations of different nature it is hardly possible to doubt that it will be one of the few valuable and lasting additions to the literature on the general subject of the evolution of organic nature.

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